

RESPONSE TO NOTICE OF NON-COMPLIANT AMENDMENT

UNDER 37 C.F.R. § 1.111

U.S. Application No. 10/088,758

Q69113



AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

Claims 1-72. (canceled).

73. (Currently amended): An optical waveguide for outputting light of a substantially single predetermined wavelength, the optical waveguide comprising:

a light conducting medium (2) defining a longitudinally extending optical path (15) for guiding the light, the optical path (15) extending longitudinally between respective spaced apart first and second ends (8,9), and

a means (20,21) for causing partial longitudinal reflections of the light along the optical path (15) at at least two spaced apart partial reflecting locations (20) along the optical path (15) for deriving light of the predetermined wavelength,

~~characterised in that~~ wherein the means (20,21) for causing the partial reflections locates the reflecting locations (20) along the optical path (15) at distances from the first end (8) along the optical path (15) which are functions of the effective optical length of the optical path (15) taking account of alteration to the actual length of the optical path (15) resulting from the ~~affect~~ effect of the means (20,21) for causing the partial reflections on the actual length of the optical path (15)[[.]], so that the distances of the reflecting locations along the optical path from the first end are such that the standing waves set up between the first end and each of the reflecting locations, and the standing wave or waves set up between any two of the reflecting locations, and the standing wave set up between the first and second ends, are all in harmonic relationship with each other.

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74. (Currently amended): An optical waveguide as claimed in Claim 73 ~~characterised in that~~ wherein the means (20,21) for causing the partial reflections of the light at the at least two reflecting locations (20) comprises a refractive index altering means (21) for altering the effective refractive index of the light conducting medium (2) presented to light passing along the optical path (15) at each of the at least two reflecting locations (20) for causing the partial reflections.

75. (Currently amended): An optical waveguide as claimed in Claim 74 ~~characterised in that~~ wherein the length of each reflecting location (20) in the longitudinal direction of the optical path (15) is ~~relatively short, and preferably, the length of each reflecting location (20) in the longitudinal direction of the optical path is~~ in the range of 0.3 microns to 200 microns[[,]]. ~~and advantageously, the length of each reflecting location (20) in the longitudinal direction of the optical path is in the range of 1 micron to 4 microns.~~

76. (Currently amended): An optical waveguide as claimed in Claim 75 ~~characterised in that~~ wherein the respective lengths of the reflecting locations (20) along the optical path ~~may be~~ are the same ~~or different,~~ and the effective refractive indices of the respective reflecting locations (20) ~~may be~~ are the same, ~~or different.~~

77. (Currently amended): An optical waveguide as claimed in Claim 74 ~~characterised in that~~ wherein the distance of each reflecting location (20) from the first end (8) along the optical path is a function of the product of the actual length of the optical path (15) and the actual refractive index of the light conducting medium (2) defining the optical path, less the sum of the products of the lengths of the reflecting locations (20) and the differences between respective effective refractive indices of the reflecting locations (20) and the actual refractive index of the light conducting medium defining the optical path (15)[[,]]. ~~and preferably, the distance of each reflecting location (20) from the first end along the optical path is a function of the sum of the~~

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~~products of the lengths of the reflecting locations (20) intervening between the first end (8) and that reflecting location (20) and the differences between respective effective refractive indices of the reflecting locations and the actual refractive index of the light conducting medium defining the optical path, and advantageously, the distance of each reflecting location (20) from the first end (8) along the optical path (15) is a function of the product of half the length of that reflecting location and the difference between its effective refractive index and the actual refractive index of the light conducting medium defining the optical path, and ideally, the distance of each reflecting location from the first end (8) along the optical path (15) is a function of the actual refractive index of the light conducting medium (2) defining the light path (15).~~

78. (Currently amended): An optical waveguide as claimed in Claim 74 ~~characterised in that~~ wherein the distance of the p^{th} reflecting location (20) from the first end (8) along the optical path (15) is provided by the formula:

$$L = \frac{X \left\{ L_{\text{device}} n_{\text{device}} - \sum_i l_i \Delta n_i \right\} + \sum_{i=1}^{p-1} l_i \Delta n_i + \frac{l_p \Delta n_p}{2}}{n_{\text{device}}}$$

where:

L is the distance of the p^{th} reflecting location from the first end along the optical path,

X is the fraction of the actual optical length at which the element is to be placed,

L_{device} is the actual length of the optical path,

n_{device} is the average refractive index of the light conducting layers of the unperturbed light conducting medium of the optical path presented to the light,

l_i is the length of the i^{th} reflecting location in the direction of the optical path,

$\Delta n_i[.]$ is the difference between the effective refractive index of the i^{th} partial reflecting location and the average refractive index of the unperturbed optical path,

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$l_p[[,]]$ is the length of the p^{th} reflecting location in the direction of the optical path, and

Δn_p is the difference between the effective refractive index of the p^{th} partial reflecting location and the average refractive index of the optical path.

79. (Currently amended): An optical waveguide as claimed in Claim 74 ~~characterised in that~~ wherein the refractive index altering means (21) comprises a plurality of refractive index altering elements (20) one refractive index altering element being provided for each reflecting location, the respective refractive index altering elements being located at distances from the first end along the optical path similar to the distances from the first end of the corresponding reflecting location[[,]]. ~~and preferably, each refractive index altering element (21) is located spaced apart from an active region within which the optical path is defined.~~

80. (Currently amended): An optical waveguide as claimed in Claim 79 ~~characterised in that~~ wherein each refractive index altering element (21) is provided by a refractive index altering groove (21) formed in a medium adjacent the light conducting medium but spaced apart therefrom[[,]]. ~~and the depth of the refractive index altering grooves (21) may be the same or different, and preferably, each refractive index altering element (20) extends substantially transversely relative to the optical path (15).~~

81. (Currently amended): An optical waveguide as claimed in Claim 74 ~~characterised in that~~ wherein the respective reflecting locations (20) are formed by a dopant[[,]]. ~~and the distance from the first end along the optical path to each reflecting location is measured to the centre of the reflecting location.~~

82. (Currently amended): An optical waveguide as claimed in Claim 73 ~~characterised in that~~ wherein the optical waveguide is a waveguide for laser light[[,]]. ~~and may be a~~

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~~semiconductor laser light generating device, and may be a passive semiconductor waveguide.~~

83. (Currently amended): An optical waveguide as claimed in Claim 82 ~~characterised in that~~ wherein a ridge (14) is formed on a surface of the semiconductor laser waveguide for defining the optical path through the light conducting medium, and ~~preferably~~[[,]] the refractive index altering elements (21) are located in the ridge (14) at locations corresponding to the reflecting location[[,]]. ~~and advantageously, the refractive index altering elements (21) are located in the ridge (14) at locations directly corresponding to the partial reflecting location (20).~~

84. (Cancelled)

85. (Cancelled)

86. (Currently amended): An optical waveguide as claimed in Claim 73 ~~characterised in that~~ wherein the means (20,21) for causing the partial reflections causes the partial reflections at at least three reflecting locations (20) along the optical path (15)[[,]]. ~~and preferably, the reflecting locations (20) are provided at respective distances from the first end which correspond to the following fractions of the actual length of the optical path, namely, 1/14, 1/7, 3/14, 2/7, 3/7, 4/7 and 5/7 along the optical path.~~

87. (Currently amended): An optical waveguide as claimed in Claim 86 ~~characterised in that~~ wherein the ~~respective distances along the optical path from the first end at which the reflecting locations are located which correspond to the fractions of the actual length of the optical path of 1/14, 1/7, 3/14, 2/7, 3/7, 4/7 and 5/7 are 39.3, 78.6, 118.0, 157.3, 235.9, 314.5 and 393.1 microns for a waveguide of actual length of 550 microns, or~~ reflecting locations (20) are provided at respective distances from the first end which correspond to the following fractions of

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the actual length of the optical path, namely, 1/16, 1/8, 3/16, 1/4, 5/16, 3/8, 1/2, 5/8 and 3/4 along the optical path[[,]]. ~~or the respective distances along the optical path from the first end at which the reflecting locations are located which correspond to the fractions of the actual length of the optical path of 1/16, 1/8, 3/16, 1/4, 5/16, 3/8, 1/2, 5/8 and 3/4 are 18.74, 37.55, 56.36, 75.16, 93.97, 112.78, 150.26, 187.74 and 225.23 microns for a waveguide of actual length of 300 microns.~~

88. (Currently amended): An optical waveguide as claimed in Claim 73 comprising a plurality of optical waveguides provided in the form of an array (50)[[,]]. ~~and preferably, the wavelength of the light outputted from the respective waveguides of the array may be the same or different.~~

89. (Currently amended): An array of optical waveguides ~~characterised in that~~ wherein the respective optical waveguides of the array are optical waveguides as claimed in Claim 73.

90. (Currently amended): A method for providing an optical waveguide for outputting light of a substantially single predetermined wavelength, the method comprising:
providing a light conducting medium (2) defining a longitudinally extending optical path (15) ~~for~~ ²⁰ guiding the light, the optical path (15) extending longitudinally between respective spaced apart first and second ends (8,9), and

providing a means (20,21) for causing partial longitudinal reflections of the light along the optical path (15) at at least two spaced apart partial reflecting locations (20) along the optical path for deriving the light of the predetermined wavelength, ~~characterised in that~~

wherein the means (20,21) for causing the partial reflections are provided such that the reflecting locations (20) are at distances from the first end (8) along the optical path (15) which

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are functions of the effective optical length of the optical path (15) taking account of alteration to the actual length of the optical path (15) resulting from the ~~effect~~ effect of the means (20,21) for causing the partial reflections on the actual length of the optical path (15)[[.]], so that the distances of the reflecting locations along the optical path from the first end are such that the standing waves set up between the first end and each of the reflecting locations, and the standing wave or waves set up between any two of the reflecting locations, and the standing wave set up between the first and second ends, are all in harmonic relationship with each other.

91. (Currently amended): A method as claimed in Claim 90 ~~characterised in that~~ wherein the means (20,21) for causing the partial reflections of the light at the at least two reflecting locations (20) is provided by a refractive index altering means (21) for altering the refractive index of the light conducting medium (2) presented to light passing along the optical path (15) at each of the at least two reflecting locations (20) for causing the partial reflections.

92. (Currently amended): A method as claimed in Claim 91 ~~characterised in that~~ wherein the length of each reflecting location (20) in the longitudinal direction of the optical path (15) is ~~relatively short, and preferably, the length of each reflecting location (20) in the longitudinal direction of the optical path is~~ in the range of 0.3 microns to 200 microns.

93. (Currently amended): A method as claimed in Claim 91 ~~characterised in that~~ wherein the respective lengths of the partial reflecting locations along the optical path ~~may be~~ are the same ~~or different~~, and the effective refractive ~~index~~ indices of the respective reflecting locations ~~may be~~ are the same, ~~or different~~.

94. (Currently amended): A method as claimed in Claim 92 ~~characterised in that~~ wherein the distance of the p^{th} reflecting location (20) from the first end (8) along the optical path (15) is provided by the formula:

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$$L = \frac{X \left\{ L_{\text{device}} n_{\text{device}} - \sum_i l_i \Delta n_i \right\} + \sum_{i=1}^{p-1} l_i \Delta n_i + \frac{l_p \Delta n_p}{2}}{n_{\text{device}}}$$

where:

L is the distance of the p^{th} reflecting location from the first end along the optical path,

X is the fraction of the actual optical length at which the element is to be placed,

L_{device} is the actual length of the optical path,

n_{device} is the average refractive index of the light conducting layers of the unperturbed light conducting medium of the optical path presented to the light,

l_i is the length of the i^{th} reflecting location in the direction of the optical path,

Δn_i is the difference between the effective refractive index of the i^{th} partial reflecting location and the average refractive index of the optical path,

l_p is the length of the p^{th} reflecting location in the direction of the optical path, and

Δn_p is the difference between the effective refractive index of the p^{th} partial reflecting location and the average refractive index of the unperturbed optical path.

95. (New): An optical waveguide as claimed in Claim 75 wherein the respective lengths of the reflecting locations along the optical path are different, and the effective refractive indices of the respective reflecting locations are different.

96. (New): An optical waveguide as claimed in Claim 80 wherein the depth of the refractive index altering grooves is the same.

97. (New): An optical waveguide as claimed in Claim 80 wherein the depth of the

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refractive index altering grooves is different.

98. (New): An optical waveguide as claimed in Claim 79 wherein each refractive index altering element extends substantially transversely relative to the optical path.

99. (New): An optical waveguide as claimed in Claim 73 wherein the distance from the first end along the optical path to each reflecting location is measured to the centre of the reflecting location.

100. (New): An optical waveguide as claimed in Claim 73 wherein the optical waveguide is a passive semiconductor waveguide.

101. (New): An optical waveguide as claimed in Claim 86 wherein the reflecting locations are provided at respective distances from the first end which correspond to the following fractions of the actual length of the optical path, namely, $1/14$, $1/7$, $3/14$, $2/7$, $3/7$, $4/7$ and $5/7$ along the optical path.

102. (New): A method as claimed in Claim 91 wherein the respective lengths of the partial reflecting locations along the optical path are different, and the effective refractive indices of the respective reflecting locations are different.